

We claim:

1. A process for preparing quaternary phosphonium salts by reacting a trialkyl-, trialkenyl- or triarylphosphine with an optionally substituted monounsaturated or polyunsaturated aliphatic, cycloaliphatic or aromatic-aliphatic alcohol having from 3 to 25 carbon atoms or its carboxylic acid esters or ethers in the presence of an acid or an optionally substituted aliphatic, cycloaliphatic or aromatic-aliphatic halide having from 3 to 25 carbon atoms, which comprises carrying out the reaction in a ternary solvent mixture.

2. The process according to claim 1, wherein, to prepare quaternary phosphonium salts of the general formula I



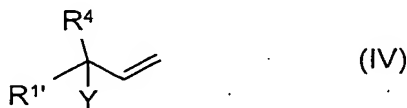
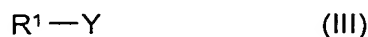
where

- R^1 is an optionally substituted monounsaturated or polyunsaturated aliphatic, cycloaliphatic or aromatic-aliphatic group having from 3 to 25 carbon atoms,
 R^2 is an alkyl, alkenyl or aryl group having from 1 to 9 carbon atoms and
 X is the anion equivalent of an organic or inorganic acid,

a phosphine of the general formula II



where R^2 has the meaning given above, is reacted with a monounsaturated or polyunsaturated electrophile of the general formula III or IV,



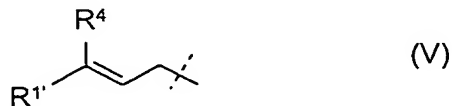
where R^1 has the meaning given above and

- R^1 is an optionally substituted, aliphatic, cycloaliphatic or aromatic-aliphatic hydrocarbon group having from 1 to 21 carbon atoms,
 Y is OH, Cl, Br, O(CO) R^3 or OR 3 and R^3 is an aliphatic hydrocarbon group having from 1 to 6 carbon atoms and

R^4 is H or CH_3

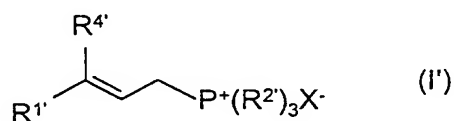
and, when an electrophile of the general formula IV is reacted,
 R^1 in formula I is a structural element of the general formula V

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where $R^{1'}$ and R^4 have the meanings given above.

- 10 3. The process according to either of claims 1 and 2, wherein, to prepare quaternary phosphonium salts of the general formula I'



where

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$R^{1'}$ is an optionally substituted, aliphatic, cycloaliphatic or aromatic-aliphatic group having from 1 to 21 carbon atoms,

$R^{2'}$ is an aryl group having from 1 to 9 carbon atoms,

$R^{4'}$ is H or CH_3 and

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X is the anion equivalent of an organic or inorganic acid,

a phosphine of the general formula II'

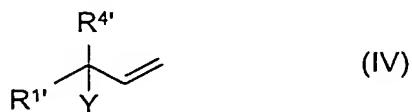
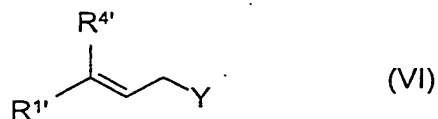
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where $R^{2'}$ has the meaning given above,

is reacted with a monounsaturated or polyunsaturated electrophile of the general formula IV or VI,

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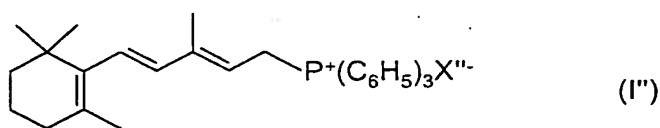
where $R^{1'}$ and $R^{4'}$ have the meanings given above and

- 5 Y is OH, Cl, Br, $O(CO)R^3$ or OR^3 and R^3 is an aliphatic hydrocarbon group having from 1 to 6 carbon atoms.

4. The process according to any of claims 1 to 3, wherein as phosphine of the general formula II use is made of triphenylphosphine.

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5. The process according to any of claims 1 to 4, wherein, to prepare quaternary phosphonium salts of the formula I''



where

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X'' is Cl, Br or HSO_4 ,

triphenylphosphine is reacted with β -vinylionol.

- 20 6. The process according to any of claims 1 to 5, wherein use is made of a ternary solvent mixture comprising water, an alcohol having from 1 to 6 carbon atoms and a hydrocarbon having from 5 to 12 carbon atoms or a mixture of various hydrocarbons having from 5 to 12 carbon atoms.

- 25 7. The process according to any of claims 1 to 6, wherein use is made of a ternary solvent mixture consisting of water, an alcohol having from 1 to 6 carbon atoms and a hydrocarbon having from 5 to 12 carbon atoms or a mixture of various hydrocarbons having from 5 to 12 carbon atoms.

- 30 8. The process according to any of claims 1 to 7, wherein use is made of a ternary solvent mixture consisting of water, methanol and a hydrocarbon having 7 carbon atoms or a mixture of various hydrocarbons having 7 carbon atoms.

- 35 9. The process according to any of claims 1 to 8, wherein use is made of a ternary solvent mixture which consists of at least 5% by weight of water.

10. The process according to claim 1 to 9, wherein use is made of a ternary solvent mixture consisting of

55 – 85% by weight of methanol
10 – 25% by weight of heptane and
5 – 20% by weight of water.

- 5 in which case the proportions chosen within said ranges must total 100% by weight.
11. The process according to any of claims 1 to 10, wherein the ternary solvent mixture is in the form of a two-phase system.
- 10 12. The process according to any of claims 1 to 11, wherein the acid is hydrochloric acid or sulfuric acid.
- 15 13. The process according to any of claims 1 to 12, wherein the solvent mixture, after the reaction is completed, is separated off from the other components of the reaction mixture and, if appropriate after setting the chosen composition by adding at least one of the components of the solvent mixture, is recirculated.
- 20 14. The use of quaternary phosphonium salts of the general formula I prepared by a process according to claim 1 to 13 for the synthesis of retinol (vitamin A), vitamin A acetate, vitamin A propionate, vitamin A palmitate, retinal, retinoic acids, β -carotene, α -carotene, δ -carotene, zeaxanthin, astaxanthin, canthaxanthin, lycopene, citranaxanthin, β -apo-8'-carotenal, crocetin, α -cryptoxanthin, β -cryptoxanthin, phytoene, lutein, bixin, capsanthin, capsorubin, β -apo-8'-carotenoic acid methyl ester, β -apo-8'-carotenoic acid ethyl ester, β -apo-8'-carotenoic acid propionyl ester or β -apo-8'-carotenoic acid palmityl ester.
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